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matter. The old argument for the existence of an ether because some medium is necessary to transfer the radiant energy from the sun to the earth has accordingly no weight. For we now see that the radiation may be its own medium, somewhat as the stream of water from a hose acts as the medium for a wave if the nozzle is shaken.

Perhaps the only new thing in this letter is that, according to the common significance of the word, radiation must be considered a form of matter. But it has seemed to me that a consideration of this fact shows more clearly than we have seen before that matter is essentially continuous, and that the fundamental thing in matter is not the positive and negative electrons but is rather electric intensity.

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#### RUSSIAN SCIENTIFIC AID

At the request of the American Relief Administration, which has been receiving, repacking and forwarding the contributions of American scientific books, journals and papers published since January 1, 1915, for distribution in Russia, I wish to ask that any further shipments from contributors to the New York warehouse (Gertzen and Company, 70 West Street, New York) of the American Relief Administration should be made prior to December 30, 1922. Up to date approximately eleven tons of scientific literature have been sent to Russia by the American committee. This committee wishes to extend its warm thanks to all donors.

In response to the appeal for some money with which to relieve the distress of the hundred Russian intellectual exiles in Berlin, I have received up to this writing \$865, of which \$500 came as a single gift from Princess Cantacuzene and the rest in five and ten dollar lots from American scientific men. I have no doubt that the total of \$1,000 asked for will be reached.

VERNON KELLOGG

NATIONAL RESEARCH COUNCIL,  
WASHINGTON, D. C.

#### SCIENTIFIC BOOKS

##### THE WATCHERS OF THE SKY<sup>1</sup>

The romance of Science is not an infrequent phrase and it describes as well as any other the dramatic and striking phases of one side of human activity. Its domain is modern because all science is modern as a recognized pursuit and one which is of good repute. It is treated in many forms which vary from the fascinating stories of Jules Verne and H. G. Wells to the lurid and generally inaccurate articles in the Sunday Press. In between, we have many an essay or address which emphasizes the picturesque features of the search for the secrets of nature. But it is new for a poet of the first rank amongst those living to recognize its claims to be classed with love, war, and the more obvious forms of nature's works and human activities for expression in verse. In one respect Mr. Noyes, who follows the great poets of the past in taking a single theme, differs from them. Homer tells of the struggle of man against man, Virgil of man against nature, Milton of man against the unseen powers; it is always warfare or struggle in which one side or the other is to conquer. Here there is no victory and no defeat. The Torch-bearers are striving to learn not by defeating nature but by cooperating with her, and the achievements of nature are of less importance than the methods by which she works. He who learns hands on his knowledge; the torch is passed, not extinguished.

From the preface we learn that the "Watchers of the Sky" is the astronomical portion of a trilogy the title of which "The Torch-bearers" describes the main idea of the treatment. There is no pretence at completeness—the poem is a story not a history—but the torch is followed with some degree of consecutiveness as it passes from the hands of Copernicus through those of Tycho, Kepler, Galileo, until Newton held it high for all the world to see. Later glimpses show William Herschel putting out his hand to take it and Sir John bearing it for a time. The setting of the whole poem places the first and last word on the summit of Mount Wilson

<sup>1</sup> By Alfred Noyes. Published by the Frederick A. Stokes Company.

where Mr. Noyes joined the group of astronomers, mechanics and laborers for the first night on which the hundred inch reflector was ready for use and took his place with them for a glance through it at Jupiter and its moons.

This bare outline is but the frame-work which Mr. Noyes built to contain the ideas he tries to set forth. He recognizes fully that the great common ground between science and poetry is the exercise of the creative imagination and in all his description pays less attention to the actual discoveries than to the ideas which led to them. Copernicus and Galileo in their interpretations of the motions of the planets and stars, Tycho in his observations for the use of future astronomers, Kepler in framing simple laws, and Newton in placing the key-stone in the arch, are to Mr. Noyes guides who lighted up the routes rather than discoverers and builders. Let lesser men string the lights which illuminate the territories of knowledge; the torch-bearers are those who show the way to them. In fact, Mr. Noyes has succeeded to a considerable extent in absorbing and emitting thoroughly modern views of what constitutes the highest achievement in scientific work.

One is tempted to much quotation to illustrate how Mr. Noyes has worked out his theme and I shall indulge in it to some extent. Some of his attempts strike the reader as achieving a high plane of expression. He has, it is true, almost wholly used the medium of blank verse, which gives him considerable freedom, but the rhythm rarely fails even when he has set himself the difficult task of setting forth some of the more technical laws of nature. While he exercises the poet's right to give such parts of the truth as will illustrate the whole, in doing so he avoids with some success the danger of making wrong statements. Kepler's three laws are given in detail: his wording of the third is rather happy:

Third, that although their speed from point to point  
Appeared to change, their radii always moved  
Through equal fields of space in equal times.

In describing Newton's experiments, he tells how

He caught  
The sunbeam striking through that bullet-hole

In his closed shutter—a round white spot of light  
Upon a small dark screen. He interposed  
A prism of glass. He saw the sunbeam break  
And spread upon the screen its rainbow band  
Of disentangled colours, all in scale  
Like notes in music; first, the violet ray,

And then, after describing how each ray was bent differently by a second prism,

Last, he took a lens,  
And, passing through it all those coloured rays,  
Drew them together again, remerging all  
On that dark screen, in one white spot of light.

The last steep is not quite clear but it gives the idea.

Mr. Noyes exhibits considerable skill in choosing the method by which he shall describe each of his characters and make them tell of their work and ideas. For the first of them, .  
The neighbours gossiped idly at the door.  
Copernicus lay dying overhead.

\* \* \* \* \*

His book has come  
From Nuremberg at last; but who would dare  
To let him see it now? They have altered it!  
Though Rome approved in full, this preface, look,  
Declares that his discoveries are a dream!  
He has asked a thousand times if it has come;

While waiting and hoping for it to come he muses on his life and work:

So, all my life I pondered on that scheme  
Which makes this earth the centre of all worlds,  
Lighted and wheeled around by sun and moon  
And that great crystal sphere wherein men  
thought

Myriads of lesser stars were fixed like lamps,  
Each in its place,—one mighty glittering wheel  
Revolving round this dark abode of man.

He was puzzled how to account for the motions of the planets and felt that he must tell the world his ideas before he goes out. Blindness comes on and they put the book in his hands:

It is here!  
Put out the lamp, now. Draw those curtains back,  
And let me die with starlight on my face.

The story of Tycho is told in full from  
The boy at Copenhagen, with his mane  
Of thick red hair, thrusting his freckled face  
Out of his upper window, holding the piece  
Of glass he blackened above his candle-flame  
who later

While his tutor slept,  
Measured the delicate angles of the stars,  
Out of his window, with his compasses,  
His only instrument.

Looking down he sees Christine, "the blue eyed peasant girl," who afterwards accompanies him to Wheen in the Sound where with the King's help he

built himself that wonder of the world,  
Uraniborg, a fortress for the truth,  
A city of the heavens.

He tells her all his hopes:

There's one way,  
And only one, to knowledge of the law  
Whereby the stars are steered, and so to read  
The future, even perhaps the destinies  
Of men and nations,—only one sure way,  
And that's to watch them, watch them, and record  
The truth we know, and not the lies we dream.

Mr. Noyes follows him through the many years of work on the island to the time when, under a succeeding ruler, support was withdrawn. He was exiled and as a result meets with Kepler who describes his last moments. The story of Tycho is perhaps the most successful effort in the volume.

Kepler is shown in his home expecting a visitor, Sir Henry Wotton, and discoursing to his wife about poets and their natures. She lets him run on and after his longest disquisition:

'John, I'm afraid!'

'Afraid of what, Susannah?'  
'Afraid to put those Ducklings on to roast.'

But the ambassador arrives early and Kepler has to fill in the time talking with him in his study. It is here he has the opportunity to tell of his work and to state the laws of planetary motion. Throughout, however, he gives the credit to Tycho:

I owed so much  
To Tycho Brahe; for it was he who built  
The towers from which I hailed those three great laws.

The story of Galileo is chiefly written round the famous trial which Mr. Noyes has apparently investigated with some care. There is here much less astronomy and physics and more philosophy. The story of the reception of his telescope is interestingly told, however, and the

author finds an opportunity to give a politician's view of a scientific discovery:

Whereat old senators, wagging their white beards,  
And plucking at golden chains with stiff old claws  
Too feeble for the sword-hilt, squeaked at once:  
'This glass will give us great advantages  
'In time of war.'

Mr. Noyes follows Isaac Newton through the productive period of his life and gives in some detail the chief of his discoveries. We have already quoted from the description of his experiments on light. There follow a few lines about

That first reflecting telescope which should hold  
In its deep mirror, as in a breathless pool  
The undistorted image of a star.

A long and faithful description of the work on gravitation follows, including the incident where Newton obtained the new value of the Earth's diameter and was too excited to finish the calculations which showed that his theory was right. Mr. Noyes gets some fun with talk of Pepys about Newton and his table, Littered with papers, cups, and greasy plates Of untouched food. I am told that he would eat His Monday's breakfast, sir, on Tuesday morning, Such was his absent way!

In the penultimate scene, Newton, now an old man, muses over his early days and his work in a letter to an old sweetheart. The last phase is put into the mouth of Dean Swift.

The "Watchers of the Sky" is probably not a literary landmark of the first order, but it is a very important and attractive addition to the growing list of volumes which are bringing scientific ideas and their history to the attention of the general public. Whatever may be said concerning its merits,—and there are decided differences of opinion possible on that score—it has certainly the excellent quality of being interesting throughout. Many will read it through for that reason alone. It is essentially a volume which should be in everyone's library especially where there are boys and girls growing up. Parents are advised to "leave it about" but not to recommend their children to read it if they wish them to enjoy it.

ERNEST W. BROWN